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The California Earthquake of April 18, 1906. By the State Earthquake Investigation Committee, A. C. LAWSON, Chairman. Washington: Carnegie Institution, 1909. Two vols. with Atlas. Vol. I, pp. xviii+451 (4to); pls. 146. With folio atlas of 25 maps and 15 sheets of seismograms.

The long delay in the appearance of the second volume of this report makes it advisable to call attention to the great importance of the part already published. Even without the second volume, this monograph is one of the most elaborate of any earthquake report that has yet appeared. The only reports inviting comparison upon this basis are those by the Naples Academy of Science on the great Calabrian earthquake of 1783 (xiv+351 folio pages with atlas and 69 plates); by Robert Mallet on the so-called Neapolitan earthquake of 1857 (830 pp.); by the French Academy of Science upon the Andalusian earthquake of 1884 (772 pp. and 42 pls.); and by R. D. Oldham upon the great Assam earthquake of 1897 (xviii+379 pp. with 42 pls. and 3 maps).

The already published text upon the California earthquake is in very large part an edited collection of extremely valuable data gathered by a large number of geologists, the work of correlation and presentation having been carried out by a geologist who has made important contributions to American geology. To the geologist, the seismologist, the engineer and builder, and to the general reader, the report is one of very great value, but its sphere of usefulness must be very much limited by the difficulty of procuring it (the already published portion is sold for \$17.50); and to some extent also by the form of publication, since the atlas intimately illustrates the text but is so unwieldy that it cannot be kept near it in any standard library. The lack of any index whatever must also be greatly regretted, since it is only by running through the table of contents that any desired subject can be located. To illustrate, one of the most valuable sections of the work describes experiments along new lines made with a shaking machine by Mr. F. J. Rogers. It is necessary to read four pages of contents in order to find the page reference, and even then the author's name does not appear.

As regards the atlas, the folio size has apparently been fixed to allow of the introduction of fifteen 30" quadrangles of the map of the United States, upon which by means of a single uninterrupted red line the general course of the earthquake rift is indicated. In view of the lack of all detail, it would seem that the relation of the rift to the topographic relief could be much better brought out upon a single map of correspondingly reduced scale. Throughout the report the attempt has clearly been to set down the

observations made, unmodified by special views of origin; and such a report must always remain of the greatest value, however much theories should change. A few pages only are devoted to discussion of results, and theories of cause are either briefly set forth or implied rather than explicitly stated. By many this will be regarded as unfortunate, since they will wish to know the lines of evidence by which the conclusions were reached. It appears with sufficient clearness that in the view of the chairman of the commission, the disturbance of April 18, 1906, was due entirely to a differential mass movement of the ground upon a single surface (or narrow zone) of fracture—the so-called St. Andreas Rift; and that all earlier historic earthquakes within the same province, with the exception of that of 1868, were likewise caused by movements upon this same rift. The earthquake of 1868 is ascribed to a similar adjustment upon the degraded fault along the north-east margin of the Santa Clara Valley and San Francisco Bay. Other possible displacements, within the same province at the same times, have in the report been excluded from consideration, perhaps because none were revealed through surface breaks.

It has further been assumed that the local energy of the disturbance was determined solely by distance from the rift, the apparent surface intensity, when not in harmony with this law, being accounted for solely by differences of elasticity within the sub-surface materials. This is certainly of very great interest, provided it is true; but the maps and printed observations do not make it by any means conclusive. Map No. 23 of the atlas (distribution of apparent intensity) does not make it appear even probable. Dr. G. K. Gilbert, a member of the commission, some four months after the earthquake, published a short paper in which he advanced the same theory, though he significantly added:

But after making due allowance for differences in natural foundation and for differences in the resisting power of buildings, there remain various anomalies for which satisfactory explanation has not as yet been found. The natural foundation of Oakland is similar to that of San José, and its distance from the earthquake origin is about the same, but the injury to its buildings was decidedly less; and *Santa Rosa, standing on ground apparently firmer than that at Oakland or San José and having a somewhat greater distance from the fault, was nevertheless shaken with extreme violence.*¹

It is too early to discuss these anomalies. With the data now in hand it seems to be true that there are outlying tracts of high intensity surrounded by areas of relatively low intensity; and these features, if they shall be fully established, will doubtless affect in some important way the general theory of the earthquake.

¹ The italics are mine.—W. H. H.

It is the discussion of such difficult but crucial points that the reader seeks in vain in the final report. Passing in review the whole history of great earthquakes, it would seem remarkable, indeed, if the cause of one were not the cause of most, if not all, such movements of the crust. A criticism of the report, which has been made by several reviewers, is that it has ignored earlier work; and, excepting only the Mallet conception of isoseismals, it seems that the report might have been written in its present form if no report upon any earthquake had ever been published.

Repetition of a recent triangulation by the U.S. Coast and Geodetic Survey was made subsequent to the earthquake and revealed important changes in the location of monuments. The report upon this resurvey by Messrs. Hayford and Baldwin is of very great interest, since a comprehensive retriangulation after a destructive earthquake has been made before in but a single instance—that of the great Assam earthquake of 1897. No attempt can be made in the compass of this review even to mention the many important subjects which are treated in the report.

W. H. H.

University Geological Survey of Kansas. Vol. IX. Oil and Gas Report, 1908 [1909]. Pp. 600; pls. and maps, 110.

The Upper Carboniferous of Kansas, because of the abundant and beautifully preserved fossils which it furnishes; because of the thickness of its exposed section and the regularly alternating structure of limestones with shaly or sandy beds, and because of the distinguished and historic names which are associated with the literature that has grown up about it, has become in some measure a standard or reference section for invertebrate paleontologists when dealing with the Upper Carboniferous of the United States. Real additions to our knowledge of this series, therefore, will be of interest to all geologists and especially to those who are engaged in stratigraphic paleontology. The latest volume of the University Geological Survey of Kansas, however, contains matter for all tastes. It is divided into eleven chapters, each of which constitutes a more or less distinct paper dealing with the wide range of subjects which the geology of Kansas naturally presents. The first chapter comprises a geological and historical account of the discovery of oil and gas (pp. 5-41). It was written by Erasmus Haworth. The second and third chapters are jointly by Erasmus Haworth and John Bennett, and give the history of field work in Kansas (pp. 42-56) and a discussion of the general stratigraphy (pp. 57-160). The three succeeding chapters are by Erasmus Haworth and are entitled, respectively, "Detailed Geology of Oil and Gas" (pp. 161-79), "Life